Ch10

Ch10

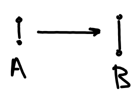
Types of Motion

Translational Motion

Ch10

Types of Motion

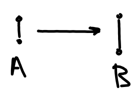
Translational Motion



Ch10

Types of Motion

Translational Motion

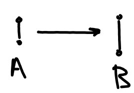


Rotational Motion

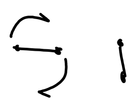
Ch10

Types of Motion

Translational Motion



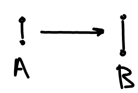
Rotational Motion



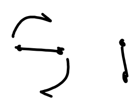
Ch10

Types of Motion

Translational Motion



Rotational Motion

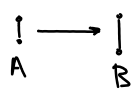


Vibrational Motion

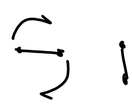
Ch10

Types of Motion

Translational Motion



Rotational Motion



Vibrational Motion

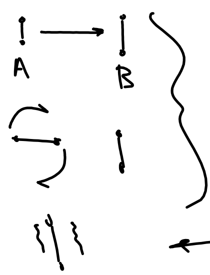
Ch10

Types of Motion

Translational Motion

Rotational Motion

Vibrational Motion



liq + gas do all 3 @ once

Solids only

Gases -

↳ Ideal Gases → conform to the Kinetic Molecular Theory of gases

Gases -

↳ Ideal Gases → conform to the Kinetic Molecular Theory (KMT) of gases

KMT

1. samples of a gas consist
of large #'s of tiny particles

KMT

1. samples of a gas consist of large #'s of tiny particles

2. particles are in a const state of motion

KMT

1. samples of a gas consist of large #'s of tiny particles
2. particles are in a const state of motion
3. particles undergo elastic collisions

KMT

1. samples of a gas consist of large #'s of tiny particles
2. particles are in a const state of motion
3. particles undergo elastic collisions (No KE lost)

KMT

1. samples of a gas consist of large #'s of tiny particles

2. particles are in a const state of motion

3. particles undergo elastic collisions (No KE lost)

4 No forces of attraction b/w particles

KMT

1. samples of a gas consist of large #'s of tiny particles
2. particles are in a const state of motion
3. particles undergo elastic collisions (No KE lost)
4 No forces of attraction B/w particles
5 KE of particles Directly prop to Kelvin T.

KMT

1. samples of a gas consist of large #'s of tiny particles
2. particles are in a const state of motion
3. particles undergo elastic collisions (No KE lost)
4. No forces of attraction B/w particles
5. KE of particles Directly prop to Kelvin T.

Real Gases

Deviate from ideal Behavior

KMT

1. Samples of a gas consist of large #'s of tiny particles
2. particles are in a const state of motion
3. particles undergo elastic collisions (No KE lost)
4. No forces of attraction B/w particles
5. KE of particles Directly prop to Kelvin T.

Real Gases

Deviate from ideal Behavior

- Polar Gas molec attract.
- Gases @ high P + low T

Basic Gas props

Expandable/compressible

Diffusion - spreading out of a gas in the absence of air currents

Effusion - passing of a gas molecule through an opening.

Basic Gas props

Expandable / compressible

Diffusion - spreading out of a gas in the absence of air currents

Effusion - passing of a gas molecule through an opening.

Low Density

↳ B/c large V, D is low

unit: $\frac{g}{L}$

Basic Gas props

Expandable / compressible

Diffusion - spreading out of a gas in the absence of air currents

Effusion - passing of a gas molecule through an opening.

Low Density

↳ B/c large V, D is low

unit: $\frac{g}{L}$

Fluidity - molecules can glide past each other (pourable)

Qualitative Description
of Ideal Gas Behavior

Qualitative Description
of Ideal Gas Behavior

4 variables

Qualitative Description
of Ideal Gas Behavior

4 variables

Volume (V) - space a gas occupies

Qualitative Description
of Ideal Gas Behavior

4 variables

Volume (V) - space a gas occupies

Temperature (T)

Qualitative Description
of Ideal Gas Behavior

4 variables

Volume (V) - space a gas occupies

Temperature (T) - Avg KE of gas molec (how fast they go)

Qualitative Description
of Ideal Gas Behavior

4 variables

Volume (V) - space a gas occupies

Temperature (T) - Avg KE of gas molec (how fast they go)
always use K in calcs

Qualitative Description
of Ideal Gas Behavior

4 variables

Volume (V) - space a gas occupies

Moles (n)

Temperature (T) - Avg KE of gas molec
(how fast they go)
always use K in calcs

Qualitative Description
of Ideal Gas Behavior

4 variables

Volume (V) - space a gas occupies

Moles (n) - number of particles

Temperature (T) - Avg KE of gas molec (how fast they go)
always use K in calcs

Qualitative Description
of Ideal Gas Behavior

4 variables

Volume (V) - space a gas occupies

Moles (n) - number of particles

Temperature (T) - Avg KE of gas molec (how fast they go)
*always use K in calcs

Pressure (P) - # of collisions gas molecules make w/ container walls

P vs T @ const n + V

P vs T @ const n + V

As T↑, P↑ b/c as T↑
particles move faster + faster
so # of collisions ↑ ∴ P ↑

P vs T @ const n + V

As T ↑, P ↑ b/c as T ↑
particles move faster + faster
so # of collisions ↑ ∴ P ↑

V vs. P @ const n + T

P vs T @ const n + V

As T↑, P↑ b/c as T↑ particles move faster + faster so # of collisions ↑ ∴ P↑

V vs. P @ const n + T

as V↑, P↓ b/c in a larger space there are less collisions B/W gas molec. so P↓

P vs T @ const n + V

As T ↑, P ↑ b/c as T ↑ particles move faster + faster so # of collisions ↑ ∴ P ↑

V vs. P @ const n + T

as V ↑, P ↓ b/c in a larger space there are less collisions b/w gas molec. so P ↓

V vs T @ const n + P

T ↑, V ↑ b/c as molecules move faster they spread out occupying a larger V.

P vs T @ const n + V

As T↑, P↑ b/c as T↑ particles move faster & faster so # of collisions ↑ & P↑

V vs. P @ const n + T

as V↑, P↓ b/c in a larger space there are less collisions B/w gas molec. so P↓

V vs T @ const n + P

T↑, V↑ b/c as molecules move faster they spread out occupying a larger V.

Vice versa to all

P vs n @ const T + V

If n ↑, P ↑ b/c more particles in the same (fixed V mean more collisions

P vs n @ const T + V

If n ↑ , P ↑ b/c more particles in the same (fixed V mean more collisions

n vs V @ const T+P

P vs n @ const T + V

If n ↑, P ↑ b/c more particles in the same (fixed) V mean more collisions

n vs V @ const T+P

If n ↑, V ↑ b/c more gas particles occupy more space.

Pressure

Pressure Measurements

$$P = \frac{\text{force}}{\text{area}}$$

Pressure Measurements

$$P = \frac{\text{force}}{\text{area}}$$

for gases P is collisions of particles w/ container walls

Pressure Measurements

$$P = \frac{\text{force}}{\text{area}}$$

for gases P is collisions of particles w/ container walls

Standard P = 760. mmHg = 760. torr = 1.00 atm (atmosphere) = 101.3 kPa (kilo Pascals)

1643 Evangelista Torricelli

1643 Evangelista Torricelli

Measured atmospheric P

using a Hg Barometer

1643 Evangelista Torricelli

Measured atmospheric P

using a Hg Barometer

STP - standard T + P

T: 0.0°C, 273 K

P: 1 atm, etc

Gas Law's

Robert Boyle
1662

Gas Law's

Robert Boyle worked w/ V + P
1662

Gas Law's

Robert Boyle worked w/ V + P
1662

Saw if P doubled, V ↓ by half

Inverse prop B/w V + P

Inverse prop B/w V + P

$$y = \frac{k}{x}$$

Inverse prop B/w V + P

$$y = \frac{k}{x}$$

$$V = \frac{k}{P}$$ @ const T + n

Inverse prop B/w V + P

$$y = \frac{k}{x}$$

$$V = \frac{k}{P}$$ @ const T + n → $VP = k$

Inverse prop B/w V + P

$y = \frac{k}{x}$

$V = \frac{k}{P}$ @ const T + n → $V_1 P_1 = k$

Inverse prop B/w V + P

$y = \frac{k}{x}$

$V = \frac{k}{P}$ @ const T + n → $V_1 P_1 = k$

V_2

Inverse prop B/w V + P

$y = \frac{k}{x}$

$V = \frac{k}{P}$ @ const T + n

$V_1 P_1 = k$

$V_2 P_2 = k$

Inverse prop B/w V + P

$$y = \frac{k}{x}$$

$$V = \frac{k}{P}$$ @ const T + n → $V_1 P_1 = k$

$V_2 P_2 = k$

$V_1 P_1 + V_2 P_2$
@ const T + n

Inverse prop B/w V + P

$y = \frac{k}{x}$

$V = \frac{k}{P}$ @ const T + n

$V_1 P_1 = k$

$V_2 P_2 = k$

$V_1 P_1 + V_2 P_2$
@ const T + n
Boyle's Law

If 37.2 mL of
a gas @ 24.0°C has
it's volume changed
to 52.3 mL, what will
the new P be if the
original P was 682 torr
and T remains const?

If 37.2 mL of
a gas @ 24.0°C has
it's volume changed
to 52.3 mL, what will
the new P be if the
original P was 682 torr
and T remains const?

$V_1 P_1 = V_2 P_2$

If 37.2 mL of a gas @ 24.0°C has it's volume changed to 52.3 mL, what will the new P be if the original P was 682 torr and T remains const?

V_1

P_1

V_2

P_2

$V_1 P_1 = V_2 P_2$

If 37.2 mL of
a gas @ 24.0°C has
it's volume changed
to 52.3 mL, what will
the new P be if the
original P was 682 torr
and T remains const?

V_1

P_1

V_2

P_2

$V_1 P_1 = V_2 P_2$

If 37.2 mL of a gas @ 24.0°C has it's volume changed to 52.3 mL, what will the new P be if the original P was 682 torr and T remains const?

$V_1 P_1 = V_2 P_2$

$V_1 = 37.2\text{mL}$

$P_1 = 682\text{ torr}$

$V_2 = 52.3\text{ mL}$

$P_2 = ?$

If 37.2 mL of a gas @ 24.0 °C has it's volume changed to 52.3 mL, what will the new P be if the original P was 682 torr and T remains const?

$V_1 P_1 = V_2 P_2$

$V_1 = 37.2 mL$

$P_1 = 682$ torr

$V_2 = 52.3 mL$

$P_2 = ?$

$P_2 = \frac{V_1 P_1}{V_2}$

If 37.2 mL of a gas @ 24.0 °C has it's volume changed to 52.3 mL, what will the new P be if the original P was 682 torr and T remains const?

$V_1 P_1 = V_2 P_2$

$V_1 = 37.2 mL$

$P_1 = 682$ torr

$V_2 = 52.3 mL$

$P_2 = ?$

$P_2 = \frac{V_1 P_1}{V_2}$

$= \frac{(37.3 mL)(682 torr)}{52.3 mL}$

If 37.2 mL of a gas @ 24.0°C has it's volume changed to 52.3 mL, what will the new P be if the original P was 682 torr and T remains const?

$V_1 P_1 = V_2 P_2$

$V_1 = 37.2\text{mL}$

$P_1 = 682 \text{ torr}$

$V_2 = 52.3 \text{ mL}$

$P_2 = ?$

$P_2 = \frac{V_1 P_1}{V_2}$

$= \frac{(37.3\text{mL})(682\text{torr})}{52.3\text{mL}}$

$= \boxed{485 \text{ torr}}$

If 12.3 mL of He
have a P of 94.5 kPa,
what is V of the He
when the P is 903 mmHg?

If 12.3 mL of He
have a P of 94.5 kPa,
what is V of the He
when the P is 903 mmHg?

$V_1 = 12.3\text{ mL}$

$P_1 = 94.5\text{ kPa}$

If 12.3 mL of He
have a P of 94.5 kPa,
what is V of the He
when the P is 903 mmHg?

$V_1 = 12.3\text{ mL}$ $V_2 = ?$

$P_1 = 94.5\text{ kPa}$ $P_2 = 903\text{ mmHg}$

If 12.3 mL of He have a P of 94.5 kPa, what is V of the He when the P is 903 mmHg?

$V_1 = 12.3\ mL$ $V_2 = ?$

$P_1 = 94.5\ kPa$ $P_2 = 903\ mmHg \times \frac{101.3\ kPa}{760\ mmHg} = 120.4\ kPa$

If 12.3 mL of He
have a P of 94.5 kPa,
what is V of the He
when the P is 903 mmHg?

$V_1 = 12.3\,mL$ $V_2 = ?$

$P_1 = 94.5\,kPa$ $P_2 = 903\,mmHg \times \frac{101.3\,kPa}{760\,mmHg} = 120.4\,kPa$

$V_2 = \frac{V_1 P_1}{P_2} =$

If 12.3 mL of He have a P of 94.5 kPa, what is V of the He when the P is 903 mmHg?

$V_1 = 12.3\,mL \quad V_2 = ?$

$P_1 = 94.5\,kPa \quad P_2 = 903\,mmHg \times \frac{101.3\,kPa}{760\,mmHg} = 120.4\,kPa$

$V_2 = \frac{V_1 P_1}{P_2} = \frac{(12.3\,mL)(94.5\,kPa)}{(120.4\,kPa)}$

$= \boxed{9.65\,mL}$

1787 Jacques Charles
worked w/ V + T

1787 Jacques Charles

worked w/ V + T

Increased T by 1, V increased by $\frac{1}{273}$

1787 Jacques Charles
worked w/ V + T

Increased T by 1, V increased by $\frac{1}{273}$

Direct Prop!

1787 Jacques Charles
worked w/ V + T

Increased T by 1, V increased by $\frac{1}{273}$

Direct Prop!

$y = kx$

1787 Jacques Charles

worked w/ V + T

Increased T by 1, V increased by $\frac{1}{273}$

Direct Prop!

$y = kx$

1787 Jacques Charles

worked w/ V + T

Increased T by 1, V increased by $\frac{1}{273}$

Direct Prop!

$y = kx \longrightarrow V = kT$ @ const n + P

1787 Jacques Charles

worked w/ V + T

Increased T by 1, V increased by $\frac{1}{273}$

Direct Prop!

$y = kx \longrightarrow V_1 = kT_1$ @ const n + P

1787 Jacques Charles

worked w/ V + T

Increased T by 1, V increased by $\frac{1}{273}$

Direct Prop!

$y = kx \longrightarrow V_1 = kT_1$ @ const n + P

$V_2 = kT_2$

1787 Jacques Charles

worked w/ V + T

Increased T by 1, V increased by $\frac{1}{273}$

Direct Prop!

$y = kx \longrightarrow V_1 = kT_1$ @ const n + P

$V_2 = kT_2 \quad \frac{V_1}{T_1} = k = \frac{V_2}{T_2}$

1787 Jacques Charles
worked w/ V + T

Increased T by 1, V increased by $\frac{1}{273}$

Direct Prop!

$y = kx \longrightarrow V_1 = kT_1$ @ const n + P

$V_2 = kT_2$ $\quad \frac{V_1}{T_1} = k = \frac{V_2}{T_2}$ $\quad \frac{V_1}{T_1} = \frac{V_2}{T_2}$

1787 Jacques Charles

worked w/ V + T

Increased T by 1, V increased by $\frac{1}{273}$

Direct Prop!

$y = kx \longrightarrow V_1 = kT_1$ @ const n + P

$V_2 = kT_2 \quad \frac{V_1}{T_1} = k = \frac{V_2}{T_2}$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$V_1T_2 = V_2T_1$

1787 Jacques Charles

worked w/ V + T

Increased T by 1, V increased by $\frac{1}{273}$

Direct Prop!

$y = kx \longrightarrow V_1 = kT_1$ @ const n + P

$V_2 = kT_2$ $\quad \frac{V_1}{T_1} = K = \frac{V_2}{T_2}$ $\quad \frac{V_1}{T_1} = \frac{V_2}{T_2}$

$V_1T_2 = V_2T_1$

Charles' Law

T must be K

A sample of C_3H_8 has a vol of 24.2 mL @ 57.3 °C, what T is the gas when it occupies 30.4 mL of space?

A sample of C_3H_8 has a vol of 24.2 mL @ 57.3 °C, what T is the gas when it occupies 30.4 mL of space?

$V_1 = 24.2\text{mL}$ $V_2 = 30.4\text{mL}$

$T_1 = 57.3°C$ $T_2 = ?$

A sample of C_3H_8 has a vol of 24.2 mL @ 57.3 °C, what T is the gas when it occupies 30.4 mL of space?

$V_1 = 24.2 mL$ $V_2 = 30.4 mL$

$T_1 = 57.3° C (+273)$ $T_2 = ?$

$= 330.3 K$

A sample of C_3H_8 has a vol of 24.2 mL @ 57.3 °C, what T is the gas when it occupies 30.4 mL of space?

$V_1 = 24.2\text{ mL}$ $V_2 = 30.4\text{ mL}$

$T_1 = 57.3°C (+273)$ $T_2 = ?$

$= 330.3\text{ K}$

$$T_2 = \frac{V_2 T_1}{V_1}$$

A sample of C_3H_8 has a vol of 24.2 mL @ 57.3 °C, what T is the gas when it occupies 30.4 mL of space?

$V_1 = 24.2\text{mL}$ $V_2 = 30.4\text{mL}$

$T_1 = 57.3°C (+273)$ $T_2 = ?$

$= 330.3\text{K}$

$$T_2 = \frac{V_2 T_1}{V_1} = \frac{(30.4\text{mL})(330.3\text{K})}{(24.2\text{mL})}$$

A sample of C_3H_8 has a vol of 24.2mL @ 57.3°C, what T is the gas when it occupies 30.4mL of space?

$V_1 = 24.2mL$ $V_2 = 30.4mL$

$T_1 = 57.3° C (+273)$ $T_2 = ?$

$= 330.3K$

$$T_2 = \frac{V_2 T_1}{V_1} = \frac{(30.4mL)(330.3k)}{(24.2mL)}$$

$= 415K$

A sample of C_3H_8 has a vol of 24.2 mL @ 57.3 °C, what T is the gas when it occupies 30.4 mL of space?

$V_1 = 24.2\text{mL}$ $V_2 = 30.4\text{mL}$

$T_1 = 57.3°C\ (+273)$ $T_2 = ?$

$= 330.3\text{K}$

$$T_2 = \frac{V_2 T_1}{V_1} = \frac{(30.4\text{mL})(330.3\text{k})}{(24.2\text{mL})}$$

$$= 415\text{K} - 273 = \boxed{142°C}$$

1808 Joseph Gay-Lussac

1808 Joseph Gay-Lussac

<u>P vs T</u> – If T ↑ by 1, P ↑ by $\frac{1}{273}$

1808 Joseph Gay-Lussac

P vs T - If T ↑ by 1, P ↑ by $\frac{1}{273}$

Direct Prop → $y = kx$

1808 Joseph Gay-Lussac

P vs T – If T ↑ by 1, P ↑ by $\frac{1}{273}$

Direct Prop → $y = kx$

$P = kT$

1808 Joseph Gay-Lussac

P vs T - If T ↑ by 1, P ↑ by $\frac{1}{273}$

Direct Prop → $y = kx$

$$P = kT$$

$$\frac{P}{T} = k$$

1808 Joseph Gay-Lussac

<u>P vs T</u> – If T ↑ by 1, P ↑ by $\frac{1}{273}$

Direct Prop → $y = kx$

$P = kT$

$\frac{P_1}{T_1} = K = \frac{}{T_2}$

1808 Joseph Gay-Lussac

P vs T – If T ↑ by 1, P ↑ by $\frac{1}{273}$

Direct Prop → $y = kx$

$P = kT$

$$\frac{P_1}{T_1} = K = \frac{P_2}{T_2}$$

1808 Joseph Gay-Lussac

P vs T – If T ↑ by 1, P ↑ by $\frac{1}{273}$

Direct Prop → $y = kx$

$P = kT$

$\frac{P_1}{T_1} = k = \frac{P_2}{T_2}$ → $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

or

$P_1 T_2 = P_2 T_1$

1808 Joseph Gay-Lussac

P vs T - If T ↑ by 1, P ↑ by $\frac{1}{273}$

Direct Prop → $y = kx$

$P = kT$

$\frac{P_1}{T_1} = K = \frac{P_2}{T_2}$ → $\frac{P_1}{T_1} = \frac{P_2}{T_2}$

or

$P_1 T_2 = P_2 T_1$ Gay-Lussac's Law

T in Kelvin

Boyle's $V_1P_1 = V_2P_2$

Charles's $V_1T_2 = V_2T_1$

Gay-Lussac's $P_1T_2 = P_2T_1$

Boyle's $V_1P_1 = V_2P_2$

Charles's $V_1T_2 = V_2T_1$

Gay-Lussac's $P_1T_2 = P_2T_1$

$V_1P_1T_2 = V_2P_2T_1$

Combined Gas Law

a sample of NO_2
has a vol of 24.5 mL @
7.62 atm and 30.4°C. what
will the vol of the gas be
@ STP?

$V_1 P_1 T_2 = V_2 P_2 T_1$

a sample of NO_2
has a vol of 24.5 mL @
7.62 atm and 30.4°C. what
will the vol of the gas be
@ STP?

$V_1 = 24.5$ mL $\quad V_2 = ?$

$P_1 = 7.62$ atm $\quad P_2 = 1.00$ atm

$T_1 = 30.4°C + 273 = 303.4$ K $\quad T_2 = 0°C = 273$ K

$V_1 P_1 T_2 = V_2 P_2 T_1$

a sample of NO_2 has a vol of 24.5 mL @ 7.62 atm and 30.4°C. What will the vol of the gas be @ STP?

$V_1 = 24.5\,mL$ $\quad V_2 = ?$

$P_1 = 7.62\,atm$ $\quad P_2 = 1.00\,atm$

$T_1 = 30.4°C + 273 = 303.4\,K$ $\quad T_2 = 0°C = 273\,K$

$V_1 P_1 T_2 = V_2 P_2 T_1$

$V_2 = \frac{V_1 P_1 T_2}{P_2 T_1}$

$= \frac{(24.5\,mL)(7.62\,atm)(273\,K)}{(1.00\,atm)(303.4\,K)}$

=

a sample of NO_2
has a vol of 24.5 mL @
7.62 atm and 30.4°C. What
will the vol of the gas be
@ STP?

$V_1 = 24.5\ mL$ $V_2 = ?$

$P_1 = 7.62\ atm$ $P_2 = 1.00\ atm$

$T_1 = 30.4°C + 273 = 303.4\ K$ $T_2 = 0°C = 273\ K$

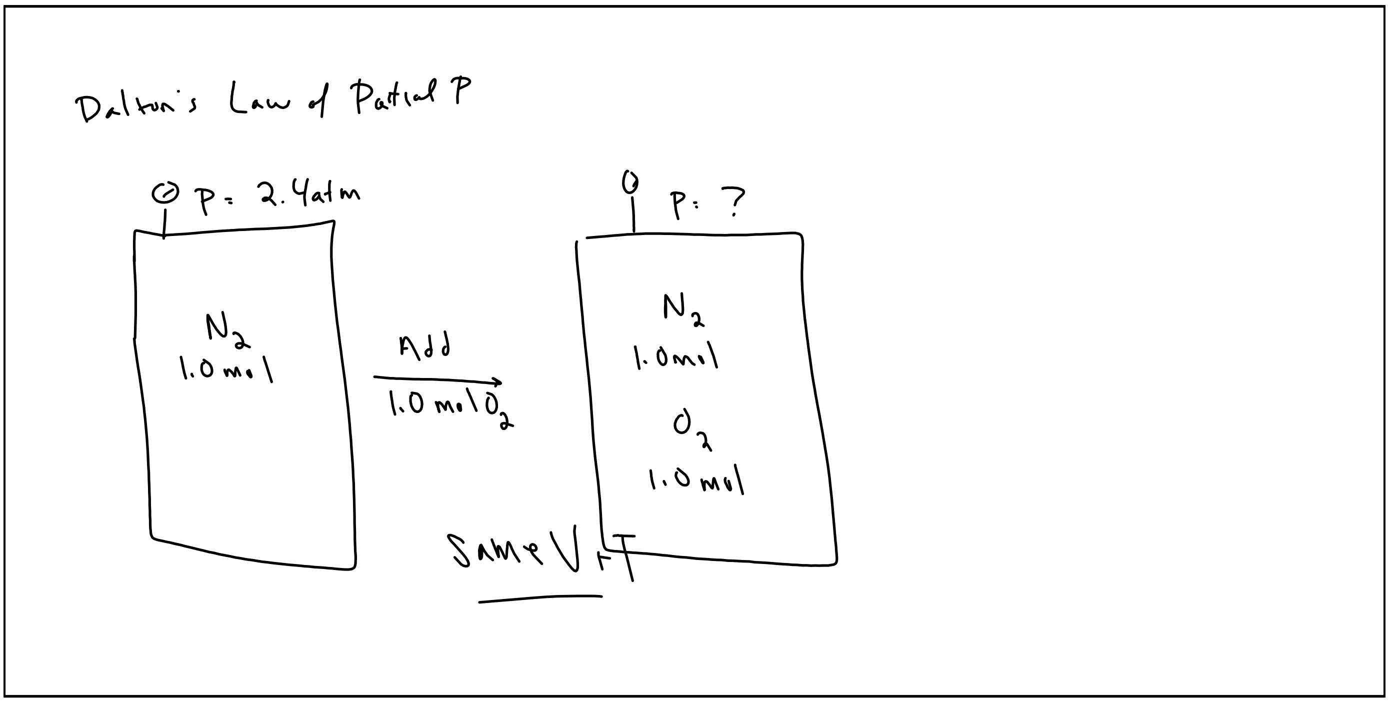
$V_1 P_1 T_2 = V_2 P_2 T_1$

$V_2 = \frac{V_1 P_1 T_2}{P_2 T_1}$

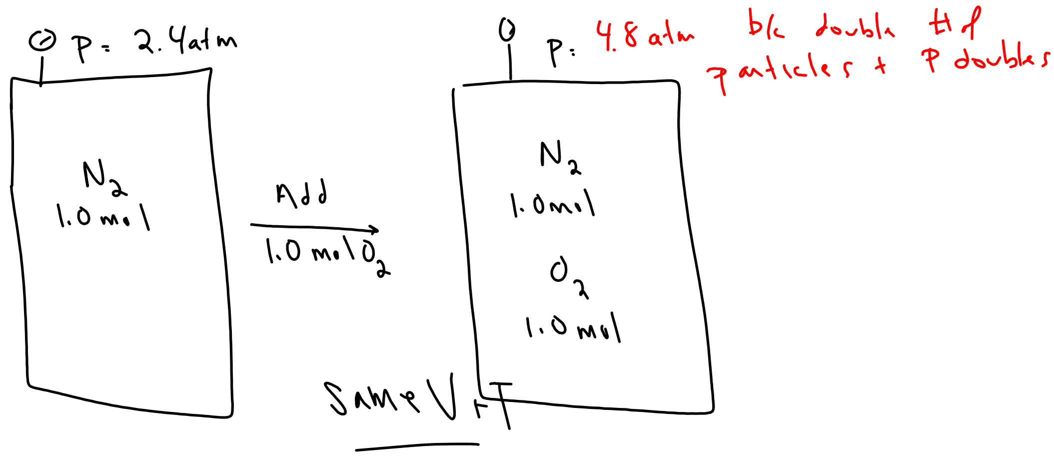
$= \frac{(24.5\ mL)(7.62\ atm)(273\ K)}{(1.00\ atm)(303.4\ K)}$

$= 168\ mL$

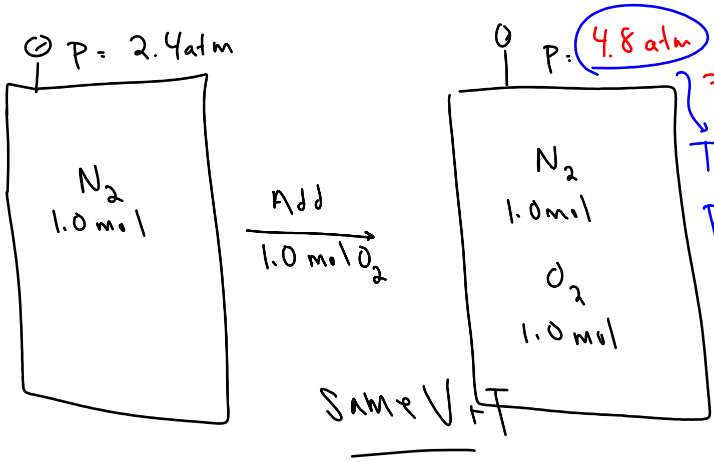
Dalton's Law of Partial P


Dalton's Law of Partial P
P = 2.4atm
N2
1.0 mol
Add
1.0 mol O2
P: ?
N2
1.0 mol
O2
1.0 mol
Same V + T

Dalton's Law of Partial P



Dalton's Law of Partial P



b/c double # of particles + P doubles

Total P (P_T)

$P_T = P_{N_2} + P_{O_2}$

Dalton's Law of Partial P

In a mixture of gases
The total P of the sample
is equal to the sum of
the partial P of each gas
present

Dalton's Law of Partial P

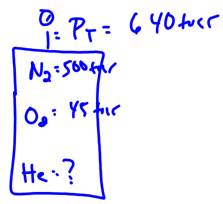
In a mixture of gases
The total P of the sample
is equal to the sum of
the partial P of each gas
present

$P_T = P_1 + P_2 + P_3$ etc

Dalton's Law of Partial P

In a mixture of gases
The total P of the sample
is equal to the sum of
the partial P of each gas
present

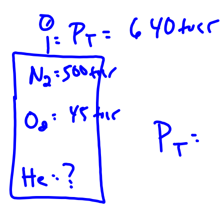
$P_T = P_1 + P_2 + P_3$ etc



Dalton's Law of Partial P

In a mixture of gases
The total P of the sample
is equal to the sum of
the partial P of each gas
present

$P_T = P_1 + P_2 + P_3$ etc



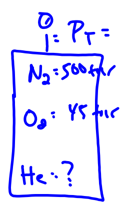
$P_T = P_{N_2} + P_{O_2} + P_{He}$

Dalton's Law of Partial P

In a mixture of gases

The total P of the sample is equal to the sum of the partial P of each gas present

$P_T = P_1 + P_2 + P_3$ etc



$P_T = P_{N_2} + P_{O_2} + P_{He}$

$640 \text{ torr} = 500 \text{ torr} + 45 \text{ torr} + P_{H}$

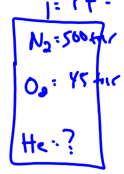
Dalton's Law of Partial P

In a mixture of gases

The total P of the sample is equal to the sum of the partial P of each gas present

$P_T = P_1 + P_2 + P_3$ etc

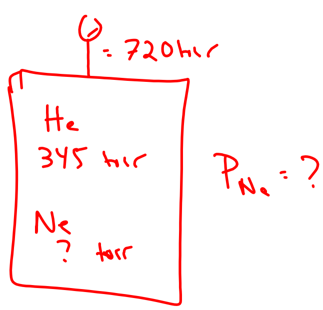
$P_T = 640$ torr

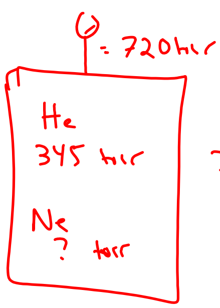


$P_T = P_{N_2} + P_{O_2} + P_{He}$

$640\text{ torr} = 500\text{ torr} + 45\text{ torr} + P_H$

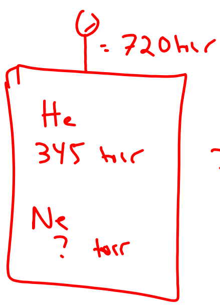
$P_{He} = 95$ torr


= 720 torr
He
345 torr
Ne
? torr
P Ne = ?



$P_{Ne} = ?$

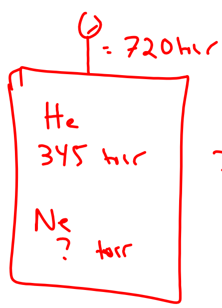
$$P_T = P_{He} + P_{Ne}$$



$P_{Ne} = ?$

$$P_T = P_{He} + P_{Ne}$$

$$720\,\text{torr} = 345\,\text{torr} + P_{Ne}$$

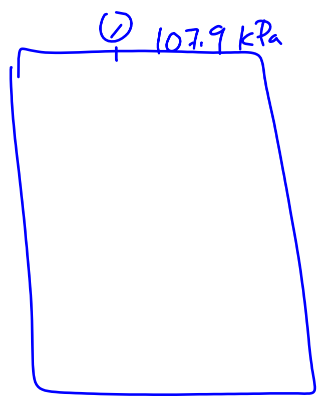


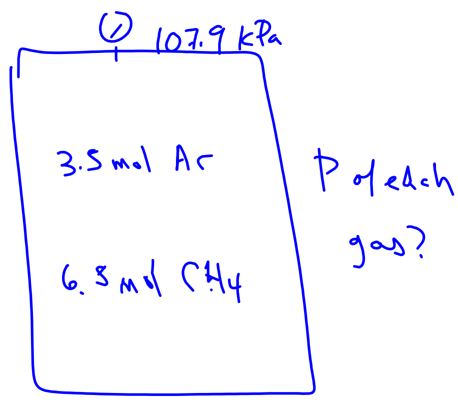
$P_{Ne} = ?$

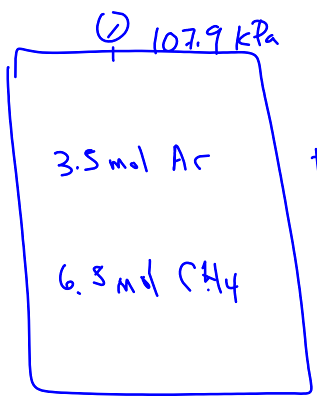
$P_T = P_{He} + P_{Ne}$

$720 \text{ torr} = 345 \text{ torr} + P_{Ne}$

$P_{Ne} = 375 \text{ torr}$

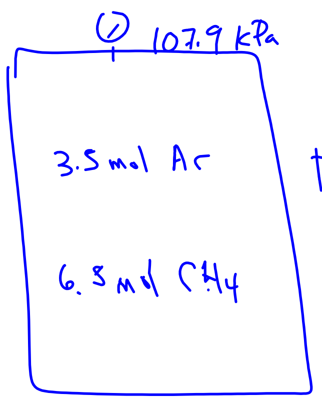

① 107.9 kPa


107.9 kPa
3.5 mol Ar
6.5 mol CH4
P of each gas?



P of each gas?

$$P_{Ar} = \frac{3.5\text{ mol}}{10.0\text{ mol}} \times 107.9\text{ kPa} = 37.8\text{ kPa}$$



P of each gas?

$$P_{Ar} = \frac{3.5\text{ mol}}{10.0\text{ mol}} \times 107.9\text{ kPa} = 37.8\text{ kPa}$$

$$P_{CH_4} = 107.9\text{ kPa} - 37.8\text{ kPa} = 70.1\text{ kPa}$$

Water Vapor Pressure (WVP, P_{wv})

Water Vapor Pressure (WVP, P_{wv})

When a gas is collected over water, some water will evaporate into the gas exerting additional P (WVP)

Now the collected gas is "wet" and we must adjust our calc's for the WVP.

If 23.2 mL of H_2 gas is collected over H_2O @ 25 °C + 738 torr of P, what is the V of the dry gas @ STP?

If 23.2 mL of H_2 gas is collected over H_2O @ 25°C + 738 torr of P, what is the V of the dry gas @ STP?
(WVP @ 25.0°C = 23.8 mm)

If 23.2 mL of H_2 gas is collected over H_2O @ 25°C + 738 torr of P, what is the V of the dry gas @ STP?

(WVP @ 25.0°C = 23.8 torr)

V_1 V_2

P_1 P_2

T_1 T_2

If 23.2 mL of H_2 gas is collected over H_2O @ 25°C + 738 torr of P, what is the V of the dry gas @ STP?

(WVP @ 25.0°C = 23.8 torr)

V_1 = 23.2 mL $\quad\quad V_2$ = ?

P_1 $\quad\quad P_2$ = 760 torr

T_1 25.0°C + 273 = 298 K $\quad T_2$ = 273 K

If 23.2 mL of H_2 gas is collected over H_2O @ 25 °C + 738 torr of P, what is the V of the dry gas @ STP?

(WVP @ 25.0 °C = 23.8 torr)

$V_1 = 23.2\text{ mL}$ $V_2 = ?$

$P_1 = 738\text{ torr} - 23.8\text{ torr} = 714.2\text{ torr}$ $P_2 = 760\text{ torr}$

T_1 25.0 °C + 273 = 298 K $T_2 = 273\text{ K}$

If 23.2 mL of H_2 gas is collected over H_2O @ 25 °C + 738 torr of P, what is the V of the dry gas @ STP?

(WVP @ 25.0 °C = 23.8 torr)

$V_1 = 23.2 mL$ $V_2 = ?$

$P_1 = 738_{torr} - 23.8_{torr} = 714.2$ torr (P_T, P_{wv}) $P_2 = 760$ torr

T_1 25.0 °C + 273 = 298 K $T_2 = 273 K$

$$V_2 = \frac{V_1 P_1 T_2}{P_2 T_1} = \frac{(23.2 mL)(714.2 torr)(273 K)}{(760 torr)(298 K)}$$

If 23.2 mL of H_2 gas is collected over H_2O @ 25°C + 738 torr of P, what is the V of the dry gas @ STP?

(WVP @ 25.0°C = 23.8 torr)

$V_1 = 23.2\text{ mL}$ $V_2 = ?$

$P_1 = 738\text{ torr} - 23.8\text{ torr} = 714.2\text{ torr}$ (P_T, P_{wv}) $P_2 = 760\text{ torr}$

T_1 $25.0°C + 273 = 298\text{ K}$ $T_2 = 273\text{ K}$

$$V_2 = \frac{V_1 P_1 T_2}{P_2 T_1} = \frac{(23.2\text{ mL})(714.2\text{ torr})(273\text{ K})}{(760\text{ torr})(298\text{ K})}$$

$= 20.0\text{ mL}$